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ASSESSMENT OF Q ANGLE AND ITS CO- RELATION TO ANTERIOR KNEE PAIN IN YOUNG ACTIVE POPULATION BETWEEN AGE GROUP 19 TO 28 YEARS

(M.S.ORTHOPAEDICS)

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ABBREVIATIONS

ACL - anterior cruciate ligament

APT - average peak torque

AKP - Anterior knee pain

AKPS - Anterior knee pain scale

ASIS - anterior superior iliac spine

BMI – Body Mass Index

E – Extension

EMG - Electromyography

F - Flexion

ICC - intraclass correlation coefficients

JAPTE - Joint angle at the PT

MVC - Maximum Voluntary Contraction

MRI – Magnetic resonance Imaging

PFPS - patello-femoral pain syndrome

SEM - standard error of measurement

TPTF - time to PT

Q angle - Quadriceps angle

WHR – Waist Hip ratio

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INTRODUCTION

Knee pain is a typical complaint brought to an orthopedist. Knee pain accounts for almost one-third of all musculoskeletal issues. Anterior knee discomfort is synonymous with terminology such as retro-patellar and patellofemoral pain. It encompasses both traumatic and degenerative conditions. [1] Anterior knee discomfort (patellofemoral pain) affects 25% of the active young population. [2]

Anterior knee pain (AKP) may be caused by muscular and biomechanical factors that change patella tracking inside the femoral trochlear notch. This contributes to an increase in patellofemoral contact pressure, which causes anterior knee discomfort and dysfunction. 3 Anterior knee discomfort is thought to have a multifactorial aetiology. [1] Activities that cause anterior knee discomfort include stair climbing and descending, hopping, running, extended sitting, kneeling, and squatting. [4] It is more frequent in young, energetic people. [1]

The most prevalent knee complaint in teenagers and young adults is anterior knee discomfort. In young active individuals, the prevalence is roughly 9%, and it may account for up to a quarter of all knee issues treated at a sports injury clinic. [5] In a research conducted in a sports medicine clinic, Nejati et al. discovered a prevalence rate of AKP of 16.7%. [6] This rate was identical to that found by Boling et al. in a study of symptomatic US Naval Academy personnel. Boling et colleagues discovered a 15% frequency in females and a 12% prevalence in men. They also discovered that the yearly incidence of AKP in female patients was 33 per 1000 persons, but only 15 per 1000 people in male patients. [7] However, since not all instances are diagnosed, the number is very certainly greater. Furthermore, with the growing popularity of sports, it is projected that the number of patients with this complaint would rise. On the other hand, as orthopaedic surgeons and general practitioners get a better grasp of this disease, this ailment should be identified more often. [8]

Despite its prevalence, anterior knee pain syndrome is the most overlooked, least understood, and most severe pathological knee ailment. As a result, the phrase "black hole of orthopaedics" used by Stanley James to characterise the present scenario is eerily accurate. In this pathologic situation, diagnostic mistakes, which may lead to needless procedures, are also rather common. [9] Georg Axhausen indicated in the German literature as early as 1922 that chondromalacia might mimic a meniscal lesion, culminating in the elimination of normal menisci. [10]

In this regard, Tapper and Hoover thought in 1969 that more than 20% of women who performed poorly following an open meniscectomy had patellofemoral pathology. [11] Similarly, John Insall reported in 1984 that patellofemoral pathology was the most prevalent cause of meniscectomy failure in young patients, particularly women. This failure was clearly the consequence of an incorrect diagnosis and, as a result, an incorrectly suggested operation. The issue of diagnostic confusion is still prevalent at the moment. This issue is reflected in the statistics below. In a surgical series, 11% of patients received unneeded arthroscopic meniscal surgery, which, rather than alleviating symptoms, aggravated them. However, following extensor mechanism realignment surgery, there was an improvement. Finally, 10% of patients in a series were referred to a psychiatrist by doctors who had already been consulted. [12]

Although the aetiology and pathogenesis of patellofemoral pain syndrome are unknown, many risk factors, such as overuse, immobilisation, excessive weight, misalignment of the knee-extensor mechanism, congenital patella anomalies, a shallow intercondylar sulcus, a deficient vastus medialis obliquus, patella alta, chronic patellar subluxation, and so on, point to an underlying genetic, After excluding anterior knee pain caused by intraarticular pathology, peripatellar tendinitis or bursitis, plica syndromes, Sinding Larsen's disease, Osgood Schlatter's disease, neuromas, and other uncommon pathologies, it

is proposed that remaining patients with anterior knee pain could be diagnosed with patello-femoral pain syndrome (PFPS). PFPS is caused by three key factors: (I)lower extremities and/or patella misalignment; (ii) lower extremity muscle imbalance; and (iii) overactivity. [13]

The knee joint is a complicated structure, and evaluating it may be difficult for orthopaedicians.[14] The Q angle is an essential measure of lower extremity biomechanical function. This measurement indicates the quadriceps mechanism's influence on the knee. [15] In clinical practise, the Q angle is simply performed for the purpose of diagnosing anterior knee discomfort. [16,17]

The Quadriceps femoris angle, often known as the Q angle, is the angle created between the quadriceps muscles and the patella tendon. The Q angle is thought to be a significant representation of the biomechanical influence of the quadriceps femoris on knee articulation motions and posture maintenance. [18]

The Q angle represents not just quadriceps muscle tension on the patella, but also the function and dysfunction of the patello-femoral articulation.It is regarded as a key diagnostic tool for determining the alignment of the knee with the hip, femur, and tibia.[19]Two imaginary lines are used to demarcate the angle.One line links the anterior superior iliac spine (ASIS) to the patellar centre.Another line links the centre of the patella to the middle of the tibial tuberosity, creating an acute angle known as the Q angle. Horton and Hall (1989), Livingston (1998, 1995), Schulties et al. [20]

In general, the usual range of Q angle values is between 12 and 20 degrees. The levels are greater in females than in men.According to Davies and Larson, typical readings for men are between 8° and 10° and for women up to 15°, with a higher value (>20°) indicating an anomaly.[21]

A lateral pull of the quadriceps femoris muscle on the patella raises Q angle value, resulting in patello-femoral diseases.As a result, understanding the Q angle value aids in the diagnosis and treatment of knee disorders.[22]Various studies have provided various normal values of Q angle for male and female.

According to Kishali et al (2004), the Q angle value ranged from 8 to 17 degrees regardless of gender, with men scoring 15- 13.5 degrees and females scoring higher.[23] Esmaeili et al. (2015) discovered a Q angle value of up to 15 degrees regardless of gender.[24] Horton and Hall (1989) found a Q angle value of 13.5 in general, with females having 15.80 and men having 11.20.[20] In general, Livingston and Mandingo (1997) assigned a Q angle value of 15-200. [25] Variations in Q angle values may be ascribed to the use of various methodologies, different postures of participants, whether or not subjects have bilateral symmetry, and the status of the quadriceps femoris muscle (whether relaxed or in contractile state). It is stated that Q angle value is a great measure of quadriceps mechanism efficacy on knee articulation and function.[26]

A link has been discovered between Q angle and several bodily factors such as gender, height, weight, femoral condylar distance, and dominant side. The greater the angle, the greater the quadriceps force. This explains why patello-femoral joint disorders arise in those who have poor quadriceps strength and hence a greater Q angle.[27] Furthermore, the Q angle value is modified by the patient's posture (standing or laying down) and the internal/external rotation of the lower leg. [28] factors that preserve knee alignment as well as strong quadriceps force are thought to be crucial for optimum sports performance. (An anterior cruciate ligament injury may be predisposed by a non-aligned knee complex articulation.) A person with a misaligned extensor mechanism of the knee, followed by anterior knee discomfort, patellar subluxation, or dislocation, will have an abnormal Q angle value.[29]

Patients who are athletic and physically active yet have latent misalignment characteristics of the pelvic, leg, foot, and knee function, determining the Q angle is critical to preventing future deterioration. Since a result, it is even more important to understand the importance of Q angle in female subjects who engage in strenuous walking, climbing stairs, and participating in sports for their health, as long-term engagement in sports activities may lead to muscle imbalance.[30]

Excessive wear and tear of patellar cartilage with damage to the articular surface of the tibio femoral articulation in athletes may cause substantial damage to the aforementioned articulations and interfere with proper knee joint motions. Q angle measurement is an essential metric for early detection of several tibio femoral pathologies such as degenerative knee diseases, anterior knee discomfort, and osteoarthritis. Because Q angle is connected to foot movements, unrestricted internal rotation of the leg as a consequence of uncontrolled pronation of the foot causes harm to the quadriceps mechanism and patella motions. As a result, excessive pronation motions may be reduced to limit such harm. Pathological disorders such as chondromalacia patella, lateral dislocation of the patella, and so on may occur. [31]

AIM & OBJECTIVES

Aim:

Assessment of Q-angle and its correlation to anterior knee pain in young active population between age group 19 to 28 years

Objectives:

A. Measurement of Q angle by goniometer

B. Measure Pain on Visual Analog Pain scoring system

REVIEW OF LITERATURE

Anterior knee pain is pain that occurs in the anterior and central aspect of the knee. Its cause can be due to a number of conditions: Patellofemoral pain syndrome, Chondromalacia Patellae, Osgood-Schlatter's disease, Sinding Larsen Johansson syndrome, Plica synovialis syndrome, Knee bursitis/Hoffa's disease, Osteochondritis dissecans, Patellafemoral instability/subluxation, Patellar tendinitis, Articular cartilage injury, Pes anserine bursitis, Quadriceps tendinopathy, Prepatellar bursitis and Iliotibial band syndrome.[32-36]

The aetiology of anterior knee pain is complicated and poorly characterised owing to the patient's range of symptoms, pain location, and pain degree. Patella abnormalities, muscle imbalances, or weakness may be underlying reasons, resulting in patella malalignment during flexion and extension. Overuse injuries may result in tendinopathy, insertional tendinopathy, patellar instability, chondral and osteochondral injury. [37]

One of the most prevalent causes of knee pain in both men and women is anterior knee discomfort. Although this illness is frequent, its occurrence and causation are not fully understood..

Because chronic injuries are common in this population, the epidemiology and prevalence of anterior knee pain have been studied most frequently in physically active individuals. [39, 40]

Furthermore, anterior knee pain has been linked to 33.2% and 18.1% of all knee injuries in females and males, respectively, highlighting the disparity in the prevalence of anterior knee pain between men and women.

The epidemiology of anterior knee pain in physically active adolescents and young adults has previously been studied; however, investigators have reported a wide range of epidemiologic incidence proportions. According to studies, students who participate in physical activity programmes had an 8.5% incidence of anterior knee discomfort. [41]

Anterior knee discomfort is widespread in sports including football, soccer, basketball, track & field, and baseball. When compared to all other knee injuries in track and field athletes, this ailment has the greatest occurrence. Anterior knee discomfort was the most often diagnosed ailment in a retrospective study of 2002 running injuries, accounting for 16% of all running injuries.[42]

The prevalence of this illness differed between males and females, with females accounting for 62% of all occurrences with anterior knee discomfort. This observation adds to the growing body of evidence that females have a greater incidence of anterior knee discomfort than men. In basketball, soccer, and baseball, anterior knee discomfort is second only to internal knee derangement in prevalence.[43] These findings indicate that anterior knee discomfort is frequent in a variety of activities, but it is more prevalent in sports where players repeatedly load the lower extremities over a prolonged period of time.

In addition to being one of the most often diagnosed knee ailments, anterior knee discomfort has a significant recurrence rate. Over 91% of patients reported continuing symptoms of anterior knee pain 4-18 years after the first diagnosis. These findings appear to support the notion that symptoms of anterior knee pain will diminish over time; however, the consequences of decreased physical activity (increased risk of obesity, heart disease, and so on) due to anterior knee pain may occur, predisposing these patients to a sedentary lifestyle.[44]

The high frequency of anterior knee pain, the recurrence of symptoms in these individuals, and the association between anterior knee pain and osteoarthritis all lend credence to the idea that anterior knee pain may be a catastrophic disease. Furthermore, females are said to have a higher prevalence of anterior knee pain than men; however, only a few studies have shown gender differences in the incidence of anterior knee pain.

Because individuals might report with a variety of symptoms, there is no precise diagnosis of anterior knee discomfort. Functional deficiency, crepitus, and/or instability may occur. Pain often arises or worsens while stepping downstairs, crouching, depressing the clutch pedal in a vehicle, wearing high-heeled shoes, or sitting for lengthy periods with the knees flexed, also known as a'movie sign.' Patients may also report some instability, particularly while going up and down stairs or across ramps. [45] Individuals suffering from overuse injuries may have a sense of instability or giving way, albeit this may not be genuine giving way (which is linked with internal knee damage), but rather a neuromuscular inhibition caused by pain, muscle weakness, patellar or joint instability. [46]

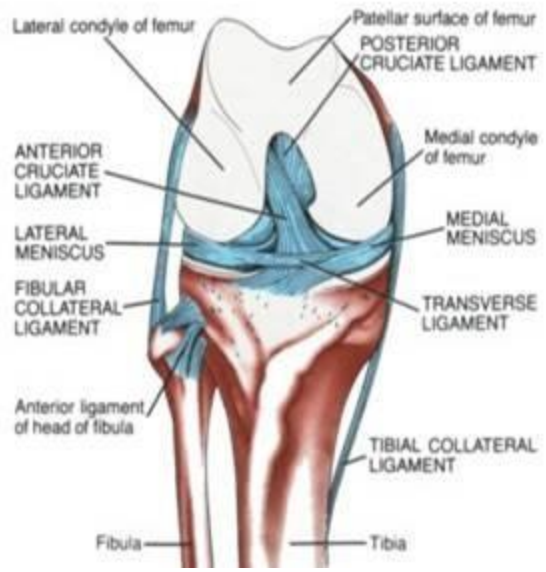
A thorough description of the pain characteristics (location, character, onset, duration, change with activity or rest, aggravating and alleviating factors, night pain) should be included in the clinical history; trauma (acute macrotrauma, repetitive microtrauma, recent/remote); mechanical symptoms (locking or extension block, instability, worse during or after activity); inflammatory symptoms (morning stiffness, swelling); effects of previous treatments and the current level of the Patients suffering from overuse anterior knee pain may have a sense of giving way or instability. This feeling is often caused by the "quadriceps inhibitory reflex," or a neuromuscular inhibition that happens as a result of discomfort, muscle weakness, patellar instability, or joint instability. True instability is indicative of internal knee derangement, which is most typically linked with anterior cruciate ligament (ACL) tears or meniscal damage.[47]

A history of past knee injury or surgery, chronic inflammatory joint disease, or bleeding diathesis is important, particularly if there is knee swelling.

The patellofemoral joint, medial tibiofemoral joint, lateral tibiofemoral joint, and superior tibiofibular joint make up the biggest joint in the body. It is a modified hinge joint with sagittal main motion (flexion – extension). During the clinical examination, the

physician should attempt to replicate the patient's knee discomfort by palpation and biomechanical evaluation. A biomechanical assessment is essential for evaluating any possible risk or contributing factors. This should involve a check for hereditary risk factors such as severe stiffness, loose joints, and/or low muscle tone. Gait and movements such as leaping, hopping (single and double-leg), and squatting should be evaluated to determine functional biomechanics . Knee edema is uncommon in cases of anterior knee discomfort and usually indicates intra-articular disease, synovitis, or a loose body. Always check the contralateral knee and ipsilateral hip. [48,49]

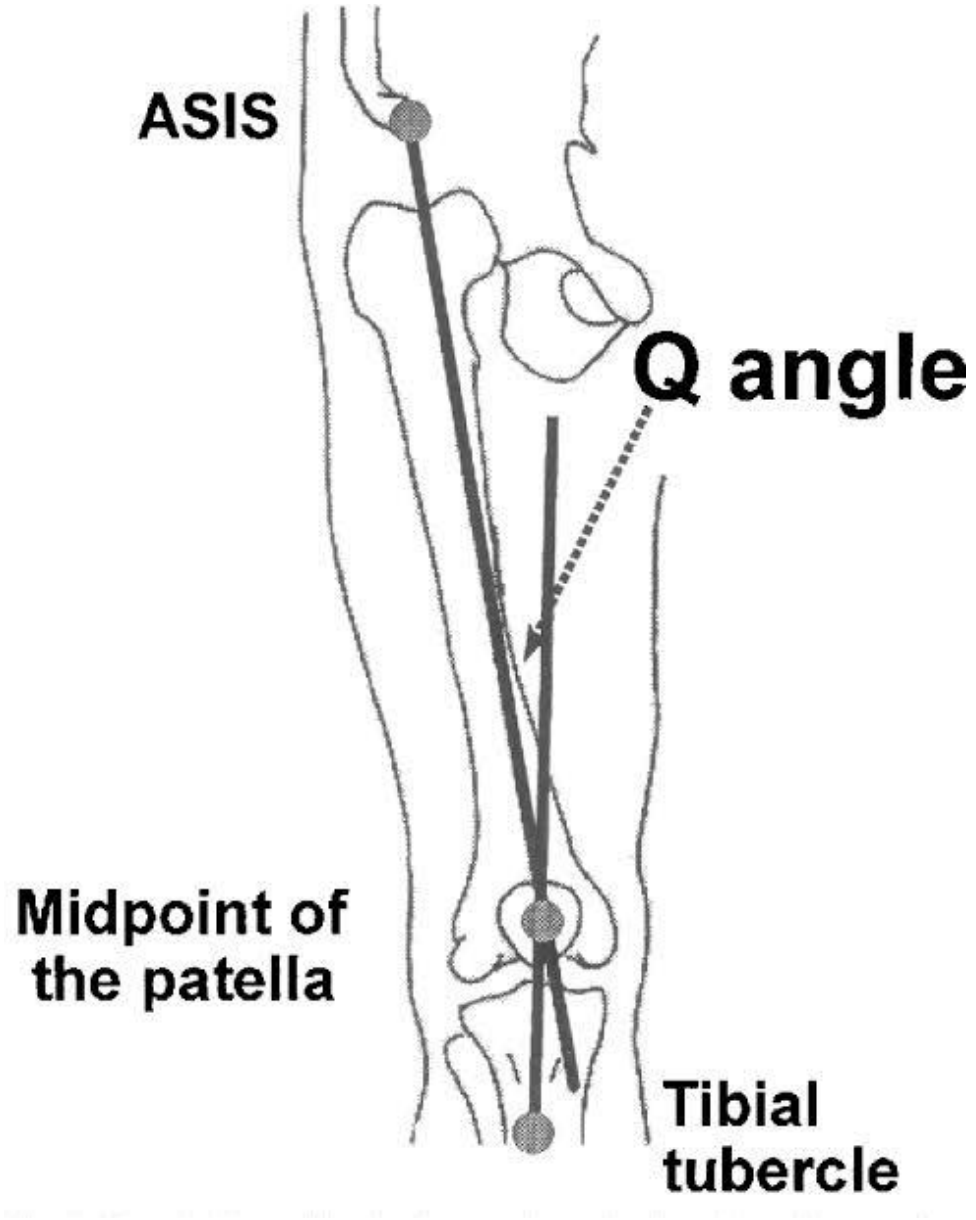
Patients with anterior knee pain localize the pain to the anterior knee and will point to the entire extensor mechanism, rather than to specific anatomic regions.[37]



Anterior anatomy of the knee.

Observation

Standing [pelvis heights, lower limb alignment, "Q" quadriceps angle (formed by the intersection of the line drawn from the anterior superior iliac spine to the centre of the patella and the line drawn from the centre of the patella to the tibial tuberosity. Normal Q angles are 8 to 12° for males and 15 to 18° for females), patellar alignment, muscle asymmetry or wasting]. [50-52]



The quadriceps "Q" angle is formed between the line joining the anterior superior iliac spine (ASIS) and the centre of the patella and the line joining the centre of the patella and the tibial tuberosity. [52]

Active movements [knee flexion (135°), knee extension (0°), internal and external rotation (10°), isometric quadriceps contraction]. Passive movements [patellar tilt, lateral tracking of patella or increased Q angle].

Surface anatomy is best appreciated with the knee flexed to 90 degrees. The point of maximal tenderness should be correlated with the underlying bone or soft tissue anatomy. Palpate and note tenderness over the patellofemoral joint, bones, menisci and along the course and attachments of ligaments and tendons. Patients with patellofemoral pain typically have tenderness over the medical and/or lateral patellar facets, superior and inferior poles of the patella or patellar tendon. Pain over the physes or joint line is not part of patellofemoral pain. Effusion [may be visible or palpable. In situations where there is minimal fluid, compression of the suprapatellar pouch may decrease the joint volume and aid detecting an effusion].[51]

Special tests

Patellar tilt test [patient supine and knee extended , Medial and lateral patellar glide, Quadriceps setting/grind test, patellar inhibition, Patellar compression test, Patellar apprehension test , Lachman test , Posterior drawer test, McMurray's test ,Trendelenberg test[51]

The knee should be moved through active range of flexion and extension and then placed through full passive range of motion. Active range of knee motion includes flexion (135°), extension (0°), internal and external rotation (10°). Muscles that span two joints are important for functional range of motion and should be tested independently (hamstrings, rectus femoris, gracilis, tensor fascia lata and iliotibial band, and gastrocnemius muscles).[52]

Studies have focused on young populations because this is a unique population due to the physical activity demands placed on them on a daily basis. Also, many of the physical activities performed are repetitive, leading to an increased incidence of overuse conditions in this population compared to the normal population.[52]

The Q angle, commonly known as the quadriceps angle, is the angle created between the quadriceps muscles and the patella tendon. Brattstrom mentioned it for the first time in 1964.[53] The measurement of the Q angle is a very important indicator of biomechanical function in the lower extremity because it reflects the effect of the quadriceps mechanism on the knee, as well as how the thigh muscles function to make the knee move and how the knee patella tracks in the groove of the knee joint. Furthermore, Q angle has come to be recognised as a significant element in measuring knee joint function and defining knee health in those who have anterior knee discomfort.[54]

When properly analysed, it will provide highly helpful information on the pelvic, leg, and foot alignment. It is without question that misalignment will impair knee function. As a result, determining the Q angle is especially important for individuals who are athletically and physically active. Furthermore, the angle of female patients who walk for health, climb stairs regularly, or engage in sports on a regular basis must be measured. [55]

The angle created by the force vectors of the quadriceps musculature and the patellar tendon is known as the Q-angle. A greater Q-angle is claimed to enhance the lateral stress vector put on the patella by the quadriceps, resulting in patella lateral tracking. The patellofemoral contact pressures may be increased by increasing or decreasing the Q-angle.

In the literature, Q-angle measurements have not been clearly related with the development of anterior knee discomfort. According to a case-control study, the average Q-angle in patients with chondromalacia patella was considerably greater than the average Q-

angle in healthy controls. Furthermore, studies have shown that greater Q-angle values are a major differentiator between runners with anterior knee discomfort and those who are not injured. [56]

The published values of Q angle by different studies vary in the literature. The typical Q angle should be between 12 and 20 degrees; males are frequently at the lower end of this range, while females have higher values.[57] Other academics' proposals that the values be as low as 10 degrees. Some studies have recently shown that levels between 8° and 10° for males and up to 15° for women are considered normal, while values greater than that might suggest an abnormality. Davies and Larson did not provide a normal value range, however they considered Q angles greater than 20° to be excessive. Q angle is considered high when it increases the lateral pull of the quadriceps femoris muscle on the patella and exacerbates patellofemoral diseases. [58]

An excessive Q angle suggests a proclivity for additional biomechanical stress during repeated knee movements because it disrupts the smooth glide of the patella in the femoral groove. Over time, particularly with sports, it will create muscular imbalance and ultimately wear away of the cartilage on the underside of the patella, resulting in the loss of the articular surface of the knee. [59] As a consequence, the resulting damage is irreversible, making full recovery following therapy difficult.

Furthermore, an excessive Q angle causes excessive foot pronation, and an increase in pronation duration causes excessive internal rotation of the tibia, which changes the quadriceps mechanism and lateral tracking of the patella. The faster development from knee dysfunction to patellofemoral arthralgia may eventually lead to degenerative joint degeneration. Controlling foot pronation may frequently mitigate the negative consequences of an irregular Q angle. [60]

Only one prospective study looked at Q-angle as a risk factor for anterior knee discomfort. The Q-angle was not substantially different between individuals who experienced anterior knee pain and those who did not acquire anterior knee pain, according to the researchers. One disadvantage of this research is that the Q-angle was assessed supine.[60]

Supine Q-angle measurement does not account for changes in lower extremity alignment in a weight-bearing posture, and prior research has shown substantial discrepancies in Q-angle measurements in a supine and standing position. Future study should look at whether Q-angle measurements in a weight-bearing posture are linked to the development of anterior knee discomfort.[61]

Excessive foot pronation has also been linked to an increased risk of anterior knee discomfort. Subtalar joint pronation is associated with internal tibial rotation, while subtalar joint supination is associated with exterior tibial rotation.

Pronation occurs during the first 30% of the gait cycle and aids in the absorption of ground response forces by the lower extremity. The tibia remains internally rotated if pronation persists beyond this stage in the gait cycle. Internal femoral rotation causes misalignment of the patella inside the femoral trochlea and compression of the lateral patellar facet.

Previous study supports the hypothesis that femoral internal rotation increases contact forces on the lateral facets of the patella, and hence excessive pronation may result in anterior knee discomfort. Tibial internal rotation, along with a valgus knee posture, raises Q-angle. An increase in Q-angle increases the quadriceps' lateral stress vector on the patella, which may result in maltracking of the patella inside the femoral trochlea.[62]

Several case-control studies have looked at static and dynamic measurements of subtalar joint pronation in those who have anterior knee discomfort. Previously studied static subtalar joint pronation assessments include rearfoot and forefoot posture (valgus or varus),

navicular drop, and arch index. With comparing patients with anterior knee discomfort to healthy persons, studies show a substantial increase in prone measurements of rearfootvarus angles (greater pronation when weight bearing).[63]

In contrast to the data above, runners with anterior knee discomfort had a much lower arch index (higher arched foot) than unaffected runners. Furthermore, lower navicular drop values (reduced pronation) have been linked to anterior knee discomfort in investigations. More study is needed to discover whether static measurements of pronation are the best predictors of dynamic pronation. [64]

Caylor D et al (1993)[65] investigated the link between quadriceps angle and anterior knee pain syndrome. Intratester Q-angle intraclass correlation coefficients (ICC) varied from.84 to.90 with the knee extended, while standard error of measurement (SEM) values ranged from 2.01 to 2.23°. The ICC for intertester Q-angle was 33, and the SEM was 2.49°. The intratester ICC was.83 for both tests with the knee flexed, and the SEM values varied from 0.68 to 2.45°. The ICC and SEM amongst testers were.65 and 3.50°, respectively. Intratester Q-angle values did not change significantly between extended and flexed knee postures. There was no significant difference in Q-angle between asymptomatic (11.1± 5.5°) and symptomatic (12.4± 5.1°) patients ($p = 0.07$). In this group of patients, increased Q-angles were not the cause of AKPS. Other variables were proposed as possible causes of their symptoms.

Mohammad-Jafar E. et al. (2007)[66] investigated the link between anterior knee discomfort and Q-angle. The mean Q-angle for males, women, and all participants in the case group was determined to be 15.2, 20.1, and 18.0 degrees, respectively. The angles in the normal control group were 12.1, 16.7, and 14.9 degrees, respectively. All of these distinctions were statistically significant. These findings support the notion that patients suffering from anterior knee discomfort had bigger Q-angles than healthy people.

Agrawal J.et al. (2013)[67] investigated the Q angle's use in assessing anterior knee discomfort. This study had two groups. The first group consisted of 50 outpatients with anterior knee pain aged 15 to 35 years. The other control group included 50 outpatients with similar age distributions who presented with various upper extremity problems but no knee problems. It was discovered that patients with anterior knee pain have larger Q-angles than healthy people. Sanchez HM et al. (2014)[68] investigated the value of Q angle in various positions, including external and internal rotations of the lower limbs. For both genders, the comparisons revealed a significant difference between standing with feet parallel and orthostatic positions with abductees feet on the left side. They also discovered a significant difference in females between supine and standing positions with abducted feet and feet parallel on the left side. They concluded that there are significant differences in standing with abducted feet and parallel to the left leg, as well as symmetry between the lower limbs independent of limb rotation in the supine posture.

Chevidikunnana M.F. et al. (2015)[69] compared and correlated goniometric Q angle measurement with radiographic Q angle measurement in patients with acute knee pain. This study included 45 participants. A significant relationship was discovered between Q angles obtained with a goniometer and x-ray imaging in the supine position. The mean difference between the goniometric and radiographic measurements of Q angle was 0.1°, which was not statistically significant. They concluded that goniometry can be used to measure Q angle as precisely as radiography, and that it can be used as a low-cost, radiation-free alternative.

Myer GD et al (2016)[70] estimated and documented the reliability and validity of the Anterior Knee Pain Scale (AKPS) in young females, as well as its relative prediction accuracy of anterior knee pain. The Anterior Knee Pain Scale (AKPS) was used to assess patellofemoral

knee pain in female athletes (n = 499). The AKPS was found to be decreased from 13 items (Coeff = 0.77, SEM = 0.004) to 6 items (Coeff = 0.78, SEM = 0.004). Point-biserial correlations with patellofemoral pain diagnosis were comparable: r [498] = 0.70 (R2 = 0.49, short form) and r [498] = 0.71 (R2 = 0.51, long form), as were sensitivity (short form) and specificity (89% (short form) and 90% (long form; AUC = 0.94 both). According to the present findings, a subset of AKPS measures are sensitive to patellofemoral pain complaints and may facilitate screening for associated diseases.

Bhaskaran B.K. et al (2016)[71] was to examine the effects of isometric quadriceps contraction on Q - angle in university female students standing and supine. All 30 subjects were measured on the right leg during isometric contraction and with the knee relaxed. The paired t-test revealed that p 0.05 = t (29) = 14.44 and the two-tailed significance is.000, indicating that there is a significant difference between knee relax and knee contraction. They came to the conclusion that there was a drop in the value of Q angle during isometric quadriceps contraction, and the size of this decrease corresponded to the magnitude of the Q angle before to the isometric contraction.

Chhabra PK et al. (2016)[72] investigated the association between anterior knee discomfort and Q-angle, as well as the presence of bilateral disparities in mean Q-angle. A total of 240 people between the ages of 19 and 35 were evaluated as cases and controls. The Q-angle was shown to be strongly linked with anterior knee pain in both men and females, with P<0.000, with females with a larger Q-angle being more prone to anterior knee pain. In addition, both men and females had bilateral variations in Q-angle. They concluded that the anatomical manifestation of Q-angle may be utilised as a tool for early prediction of anterior knee pain, substantiating the necessity for lifestyle changes to combat this disease in its early stages

Sharma S D et al (2017)[73] measured the quadriceps angle (Q angle) in individuals with anterior knee discomfort. A total of 124 symptomatic knees from 100 individuals were

examined. They discovered that the mean Qangle was 15.57 degrees; the mean Q-angle of symptomatic knees was 16.62 degrees (male-14.55, female19.05), while the mean Q-angle of asymptomatic knees was 13.84 degrees (male-12.65, female-15.39). Females had a mean q-angle of 17.71 degrees, whereas males had a mean q-angle of 13.81 degrees. They observed that females and symptomatic knees with anterior knee discomfort had considerably higher Q-angles.

Dileep KS et al (2017)[74] investigated the relationship between rearfoot posture and Q-angle in patellofemoral pain syndrome patients. This research included sixty patients who met the study's inclusion criteria. Pearson product moment correlation revealed that 27% of individuals had a rearfoot valgus angle and 73% had a rearfoot varus angle. The Q-angle for rearfoot varus was statistically significant as compared to rearfoot valgus, according to the T test. They came to the conclusion that rearfoot varus is more often connected with patellofemoral pain syndrome. The Q-angle rises in both rearfoot varus and valgus individuals, but much higher in those with rearfoot varus.

Prakash V et al (2017)[75] investigated the relationship between BMI, WHR, and Q-ANGLE in participants with primary OA knee. They discovered that the mean and standard deviation of BMI, WHR, and Q-ANGLE were 27.28± 4.05 kg/m2, 0.91± 0.07, and 19.7° ±2.06°, respectively. There was a substantial positive association between BMI and Q-ANGLE among these three factors. Only when there was an insignificant positive association between BMI and WHR was there an insignificant negative connection between WHR and Q-ANGLE. They determined that these three independent risk variables for primary OA were also interconnected risk factors for the same.

Kumar C. et al. (2018)[76] investigated the link between Q-angle and AKP. This research comprised 100 individuals with AKP in total. A total of 122 knees were assessed in 100 cases (52 females and 48 males) and 100 knees in 100 control group, with a mean age of 25.5 years

in case and 25.4 years in control group. They discovered that the average duration of AKP was 7.13 months. In 40 instances, the left knee was implicated, the right knee was involved in 38 cases, and both knees were involved in 22 cases. The mean Q-angles for males, women, and all case group members were 15.2°, 20.4°, and 17.9°, respectively. The angles in the normal control group were 12.2°, 16.3°, and 14.3°, respectively. All of the differences between the cases and controls were statistically significant. They found that those with AKP had a larger Q-angle than healthy people.

Saç A et al. (2018)[77] studied the relationship between the Q angle and isokinetic knee strength and muscle activation. Negative correlations were discovered between the Q angle and the average peak torque (APT) in extension (E) and flexion (F), the average power (APE,F) at all angles, the joint angle at the PT (JAPTE) at 240, 180, 120, and 60°•s-1; JAPTF at 300, 240, and 180°•s-1; and the time to PT (TPTF) at 180°•s-1. The Q angle and TPTE (at 60°•s-1) showed a favourable connection. There was no significant link identified between the Q angle and the degree of EMG activity in the muscles at any angular velocity, as well as the VM:VL EMG activity ratio. They came to the conclusion that a larger Q angle is related with lower isokinetic knee strength, power output, and torque angles.

Choudhary R et al (2019)[78] examined quadriceps angle (Q angle) values to age, weight, height, gender, bilateral and postural changes, and demanding activities on the weight bearing limbs in order to detect its variability. Females showed statistically significant greater Q angles in both knees than men in either group, but the difference between males in both groups was trivial. It was more common on the left side (42.36%) than on the right, in both men and females. The majority of participants increased their angle from supine to standing. Height and Q angle showed a negative connection with both standing and supine position in all three groups. Weight and age had no significant relationship with Q angle. Physical exercise had no discernible influence on the angle. They came to the conclusion that the Q

angle is an essential metric for assessing quadriceps muscle function and its influence on knee function. An increase in the angle is definitely linked to patellofemoral issues.

Khasawneh RR et al (2019)[79] studied to measure the normal Q angle values range in the Arab nationalities and determine the correlation between Q angle values and several body parameters, including gender, height, weight, dominant side, and the condylar distance of the femur. It was found that Q angle was greater in young women than young men. Also, the analysis of the data revealed an insignificant increase in the dominant side of the Q angle. In addition, the Q angle was significantly higher in the taller people of both sexes. However, the Q angle did not present any considerable correlation with weight in the study population; conversely, it was clearly observed that there was a link with the condylar distance of the femur in both sexes.

ABDELAZIZ T.T. et al. (2020)[80] investigated the usefulness of MRI in the assessment of anterior knee pain. This study included 25 participants. The current investigation discovered 26% patellar tendon diseases (patellar Tendinopathy 21% and Osgood Schlatter disease 5%). Quadriceps tendon disorders accounted for 10% of the total, with (Quadriceps Tendinopathy 5% and Quadriceps Tendon Tear 5%). Patellar disorders were found in 69% of the sample size, and they include (chondromalacia patella 32%, patellar instability 21%, transient patellar dislocation 11%, and painful bipartite patella 5%). They concluded that MRI is a generally safe, accurate, and specific modality that has been demonstrated to be the modality of choice in the diagnosis of various knee pathologies that cause anterior knee pain in various age groups.

Songur A et al (2020)[81] compared the change of the Q angle in relaxed or maximum voluntary contraction (MVC) of the quadriceps using a standardised measurement method in patellofemoral pain syndrome patients (PFPS). In this research, 34 sedentary female patients with PFPS were included. A manual extendable fixedarm goniometer was used to take

measurements. They discovered that for the first measurement, the patient was positioned in a supine posture with his quadriceps relaxed. The axial rotation neutralising equipment was used to neutralise lower extremity rotation (ARNA). For the second measurement, the midpoint of the patella was re-marked while the quadriceps was maximally contracted in the same position, and the measurement was repeated. The Q angles measured in relaxed quadriceps and MVC were 18.44°± 2.80° and 16.41° ±2.83°, respectively. There was no correlation found between the participants' age, height, weight, body mass index (BMI), leg length, and Q angle measurements. Finally, this measuring approach provided estimates that confirmed the influence of the quadriceps on the Q angle in individuals with PFPS.

Prieto-Garca LF et al (2021)[82] investigated the treatment impact of two muscular strengthening exercise regimens in PFPS patients aged 15 to 40 years from Bogotá, Colombia. This research comprised 40 participants with a low to moderate degree of physical exercise. Participants were randomly assigned to one of two intervention groups: Group A: an 8-week programme of core, hip, and knee muscle strengthening exercises; Group B: an 8-week programme of hip and knee muscle strengthening exercises. The Visual Analog Scale and the Kujala Anterior Knee Pain Scale were used to assess pain. The addition of core muscle strengthening exercises to standard therapy enhanced the quality of life of individuals in intervention group A, where a substantial decrease in pain was noted, with a statistically significant change in overall Kujala scale score. They found that incorporating core muscle strengthening activities in the conservative therapy of PFPS improves its efficacy in reducing pain and improving patients' quality of life.

Borschneck G et al (2021)[83] looked at a number of possible risk variables that might be connected to the beginning of anterior knee discomfort. The total rate of AKP in the population investigated was determined to be 7.4%. The findings revealed that a history of knee discomfort, age, and higher sports involvement were all strongly associated with

an elevated risk of AKP. Females were substantially more likely than men to have AKP. The binomial model was influenced by gender, height, age, total athletic activity, participation in particular sports, and a history of knee injury.

Chaudhary et al. (2022)[84] sought to determine whether metric (condylar distance/quadriceps angle) is a better predictor of knee discomfort in a young Indian population. 130 people with anterior knee discomfort were separated into two groups: sedentary people and athletes. In both the sedentary and sportsperson groups, statistically significant sexual variation in quadriceps angle and condylar distance was detected. Females exhibited a greater Q angle value than men. The difference in quadriceps angle between the sedentary and sportsperson groups was statistically significant. Cohen's kappa coefficient for Q angle was 0.72, whereas it was 0.49 for bi-condylar distance. They came to the conclusion that the Q angle is a stronger predictor of anterior knee discomfort than the condylar distance. Females in both categories, sedentary and sportsperson, exhibited larger Q angles than men, rendering them more prone to patellofemoral joint diseases.

Phatama KY et al (2022)[85] examined the Q-angle and other anthropometric factors in the adult population of Indonesians with and without AKP. This research involved 40 participants. They observed that the mean Q-angle in the comparison group was 20.60±1.26° and 14.85±0.99° in the control group. These distinctions were all statistically significant. There was no significant relationship between anthropometric measures (body weight, height, and BMI) and AKP. They came to the conclusion that the Q-angle may be utilised to predict the risk of AKP in females. The higher the Q-angle, the greater the risk of AKP. AKP risk could not however be predicted by anthropometric parameters.

MATERIALS AND METHOD

This cross-sectional observational study entitled "**ASSESSMENT OF Q ANGLE AND IT'S CO- RELATION TO ANTERIOR KNEE PAIN IN YOUNG ACTIVE POPULATION BETWEEN AGE GROUP 19 TO 28 YEARS**" was conducted after clearance from Board of Studies and Ethical committee in the Department of Orthopaedics, Santosh Medical College and Hospital, Ghaziabad (UP).

Study Period:

The study was conducted from April 2021 to March 2022.

Study Setting:

The study was carried out among young patients (aged 19 to 28 years) experiencing Anterior Knee Pain reporting to the Orthopaedics OPD at Santosh medical College, Ghaziabad (UP).

Study Area:

Department of Orthopaedics, Santosh Medical College, Ghaziabad (UP)

Study Population (Sample size):

A sample of minimum 92 individuals was calculated using Open Epi v3.0 software .

A small sample size was accepted due to limited time period of 1 year allocated for study at Santosh medical college

Ethical Approval:

Ethical Approval was obtained from the Institutional Ethical Committee after presenting the study protocol.

Informed Consent:

A written Informed Consent was obtained from each patient before clinical examination and data collection. The involvement of the subject was completely voluntary and deliberate.

SELECTION OF CASES

Inclusion Criteria:

1. Patients reporting to Santosh Medical college with Anterior Knee Pain (AKP)
2. Patient between age group 19 to 28 years.
3. Patients agreeing with "written and informed consent"

Exclusion Criteria:

Cases with the following findings were excluded:

1. All patients below 19 years and above 28 years.
2. No history of trauma to knee including intraarticular fracture
3. No History of any previous synovitis or infection in knee
4. No History of ankle pathology
5. No previous hip pathology
6. Pregnant patients, or immuno-compromised patients
7. Patient with neurological condition
8. Patients refusing to give informed consent

Study procedure

After approval from the Institutional Ethical committee all patients were selected as per inclusion criteria. A detailed history, complete physical examination and routine & appropriate investigations were done for all patients.

A total of 92 young patients aged between 19 years to 28 years (active age group) reporting to Santosh Medical College, Ghaziabad (UP) with Anterior Knee Pain (AKP) and not currently undergoing any other treatment were included in the study, and were be further examined.

The details of patient's particulars, as well as socio-demographic details were recorded by the investigator. The details of the complaint were recorded in a pre-fabricated case history format. The case history format includes chief complaint, and details of duration of illness, along with medical history. A written questionnaire was filled out prior to sampling, focusing on patient.

A brief description of the procedure had to be explained to the subjects once their age, gender, weight and height are recorded. Subjects had to instructed to be bare foot throughout the procedure and the quadriceps muscle has to be kept relaxed (without quadriceps voluntary contraction).

Measuring the "Q" angle in standing Position:

All possible demographic details like age, gender, occupation, height, weight and Body Mass Index (BMI) were obtained. The Q-angle of knee was measured for all participants, using a universal goniometer in standing position. The anterior superior iliac spine, the centre of the patella and the tibial tubercle were identified and marked with a removable skin marker pen.

The subjects were instructed to hold one end of a string at the anterior superior iliac spine. The other end of the string would be taped just inferior to the midpoint of the patella, such that the pen mark is still visible. The centre of the goniometer would be placed at the midpoint of the patella. One arm of the goniometer were aligned with the string leading to the anterior superior iliac spine, and the other arm of the goniometer would be aligned with the tibial tubercle.

The subject had to be instructed to stand erect in weight bearing position with the subject decently exposed to show the landmarks. The anatomical landmarks were located through palpation and then marked with a marker. Each subject had to assume the Romberg stance anatomical position with the knees extended without voluntary quadriceps contraction. The anatomical landmarks already marked were then be joined by the use of a meter rule and a marker.

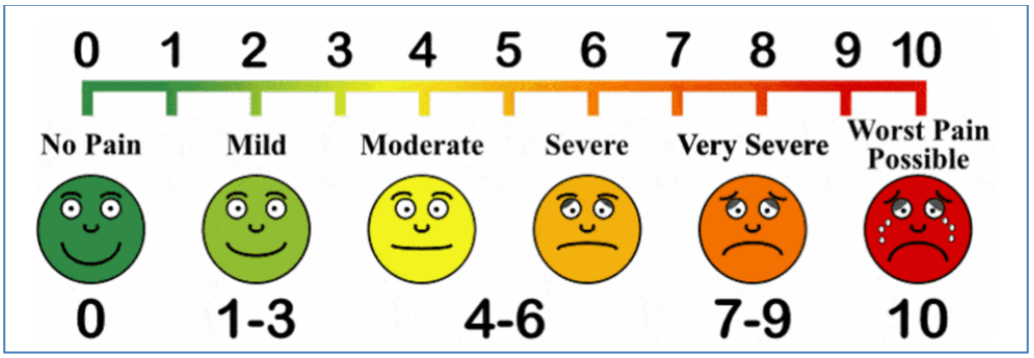
With the pivot of the goniometer placed on the mid-point of the patella, the stationary arm on the line adjoining the ASIS to the mid-point of the patella, and the moveable arm placed over the line adjoining the tibia tubercle to the mid-point of the patella. The angle thus formed between the two arms of the goniometer were then be measured and recorded as the Q-angle. Bilateral measurements of the Q-angle were taken and recorded on each subject.

Radiological Investigations:

Radiological investigations would be done in the form Xray (A. P/LAT) C.T and/or MRI, were obtained as considered relevant for routine evaluation of a patient of anterior knee pain.

Visual Analog Scale:

Patient were handed over a written performa with printed visual analog score and the records were evaluated. Participants' overall assessment of pain was measured with a 10 score VAS for their worst (VAS). The data of all subjects were recorded and statistically analyzed.



Goniometer

A device known as a goniometer is one that either measures an angle or allows for the rotation of an item to a predetermined position. In the field of orthopaedics, the first definition fits more accurately. Goniometry refers to both the art and the science of measuring the ranges of motion of joints in each of the joint's planes. The phrase "goniometry"

originates from two Greek words: gonia, which means angle, and metron, which means to measure. Together, these terms form the modern English word "goniometry." A Dutch physician and mathematician by the name of Gemma Frisius is credited with making the first recorded usage of a crude form of the modern-day goniometer. Frisius used the instrument to calculate and record the location of celestial bodies with regard to Earth.

Types of Goniometers

1. Universal Goniometer - comes in two forms: short arm and long arm.

   The short arm goniometer is used for smaller joints like the wrist, elbow, or ankle,

   The long arm goniometers are more accurate for joints with long levers like the knee and hip joints.

2. Twin Axis Electrogoniometer: The electrogoniometer has greater inter-rater and intra-rater reliability than the universal goniometer, but it is more difficult to use in clinical patient evaluations, hence it is more frequently employed for research.
3. Gravity Goniometer/Inclinometer: On one of the arms, there is a pointer that is weighted so that it remains upright even when subjected to the force of gravity.
4. Software/Smartphone-based Goniometer: Utilizing a smartphone in place of a traditional digital goniometer offers a number of advantages, including portability, availability, simplicity of measurement, and application-based tracking of data. In order to determine the joint angles, these programmes make use of the accelerometers included in smartphones.
5. Arthrodial Goniometer: Excellent for determining cervical rotation, anteroposterior and lateral flexion, as well as flexion of the cervical spine.

Of all the types, a universal goniometer is most widely used.

Statistical analysis

After the data were formulated into the spreadsheet using Microsoft excel, the statistical analysis was carried out using the statistical programme SPSS version 25.0. The information pertaining to the quantitative variables (numerical variables) was presented in the form of the mean and standard deviation, whereas the information pertaining to the qualitative variables (categorical variables) was presented in the form of the frequency and percentage of each category.

The student t-test was applied for the purpose of analysing the differences in mean values between the two groups, while the chi-square test was utilised for the purpose of analysing the frequency differences between the two groups. If the p-value was less than 0.05, then it was considered to be statistically significant. If the p-value was greater than 0.05, then it was not.

RESULTS

The study was carried out among young patients (aged 19 to 28 years) both males and females experiencing Anterior Knee Pain reporting to the Orthopaedics OPD at Santosh Medical College, Ghaziabad (UP).

A total of 92 patients were recruited in the study. In the present research, patients experiencing Anterior Knee Pain in the prescribed age group consenting to the study were included.

Socio-demographic profile of the study participants

Table 1: Age-wise distribution of study patients (n=92)

Age group	Frequency	Percent (%)
19-21 yrs	6	6.5%
22-25 yrs	28	30.4%
26-28 yrs	58	63.0%
Total	92	100.0%
Mean±SD	25.73±2.35 (19-28)	

The age wise distribution of study patients showed that the mean age of the study group was 25.73±2.35 years (mean±SD) (Table 1). The maximum number of patients were seen in the 26-28 year age group, having 63% subjects, followed by 22-25 years age group, having 30% subjects, and lastly the 19-21 years age group, having 7% subjects (Figure 1).

Figure 1: Age wise distribution of study patients:

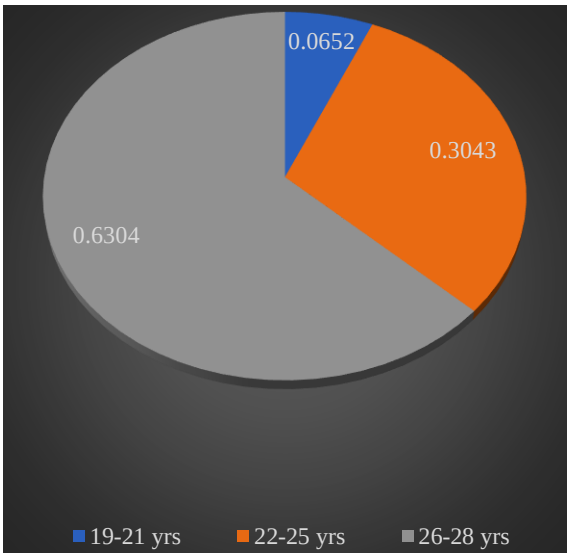


Table 2: Gender distribution of the study sample

Gender	Frequency	Percent (%)
Males	33	35.9%
Females	59	64.1%
Total	92	100.0%

The gender wise distribution in study patients showed that majority of them were females (64%) and 36% were males (Table 2 and Figure 2). The gender distribution, however, was rather similar in all age groups.

Figure 2: Gender distribution of study participants:

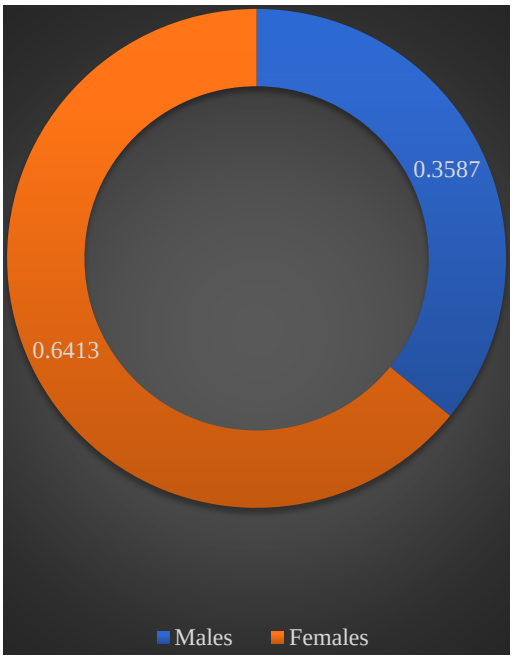


Table 3: Participant profile of the present study:

Participants profile		Frequency	Percent (%)
Working status	Working	48	52.2%
	Not working	44	47.8%
Education	Secondary level	10	10.9%
	Graduate	64	69.6%
	Post-graduate	18	19.6%
Socio-economic status	Lower	12	13.0%
	Lower-middle	39	42.4%
	Upper-middle	22	23.9%
	Upper	19	20.7%

Table 3 represents a profile of the study participants included in the study. More than half of study participants were working (52%), and 48% were unemployed / not working. A majority of study participants were educated to graduate level (70%), nearly 19% of them had studied up to post-graduate level and 11% had education only up to secondary level. Majority of study participants belong to lower-middle socio-economic group (42%), followed by upper-middle (24%), upper group (21%), and lastly the lower SES group (13%) (Figure 3).

Figure 3: Participants profile in the present study:

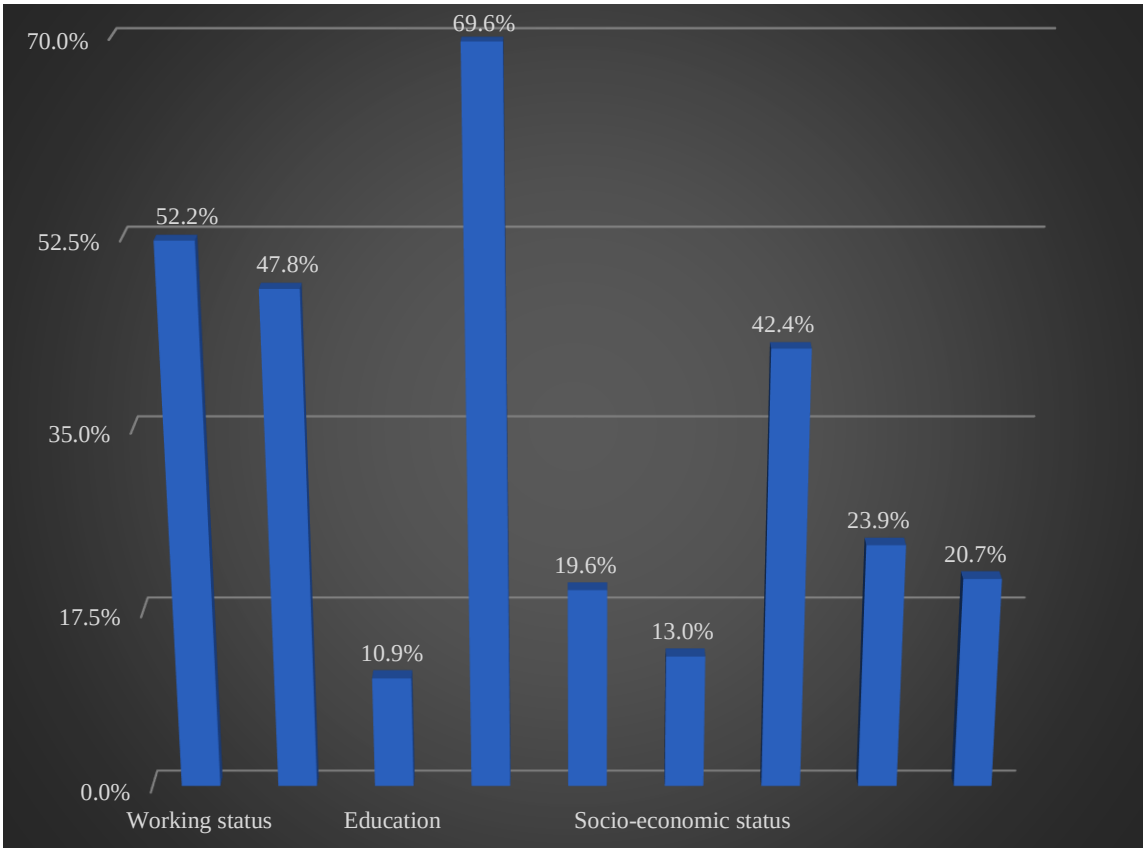


Table 4: Knee involved in AKP

Knee involved in AKP	Frequency	Percent (%)
Both	37	40.2%
Right	24	26.1%
Left	31	33.7%
Total	92	100.0%

Table 4 depicts the side of knee involvement among study sample. Majority of the patients had unilateral involvement (59.8%) and 40.2% had bilateral involvement. Right and left side involvement was not significantly different among the population (Figure 4).

Figure 4: Other clinical features of the study sample:

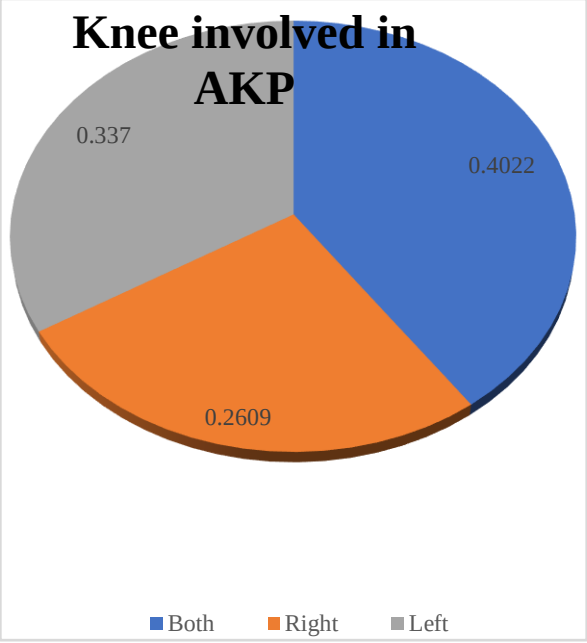
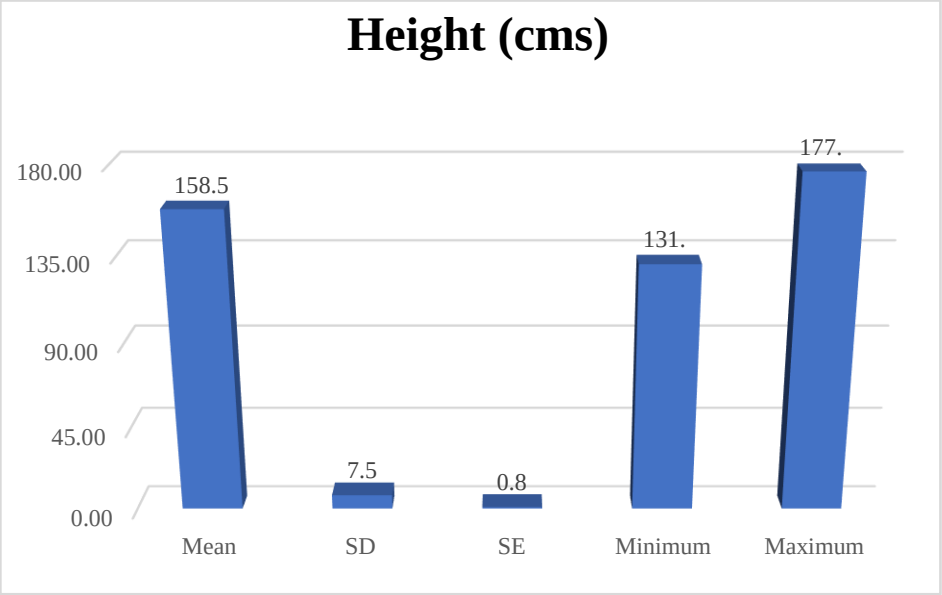
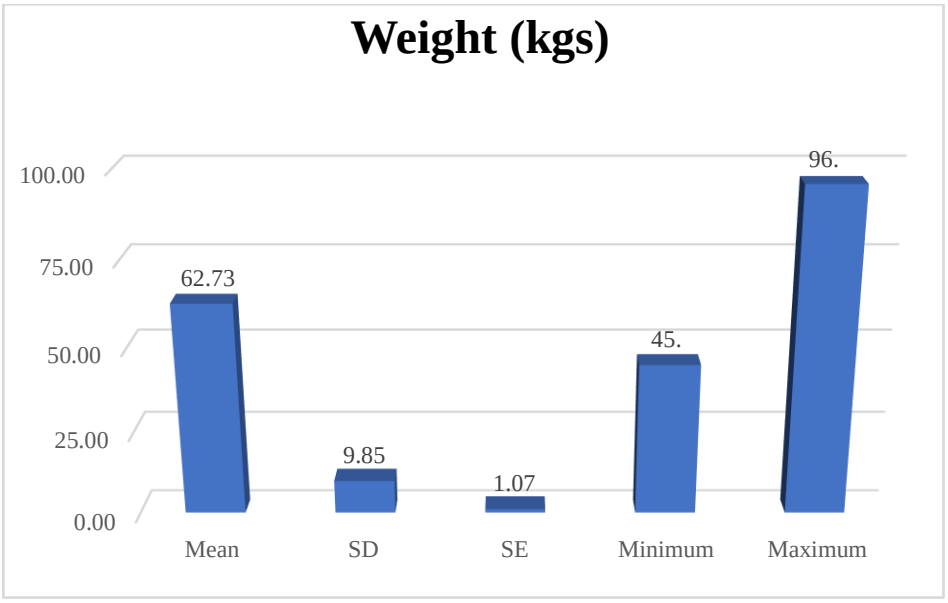


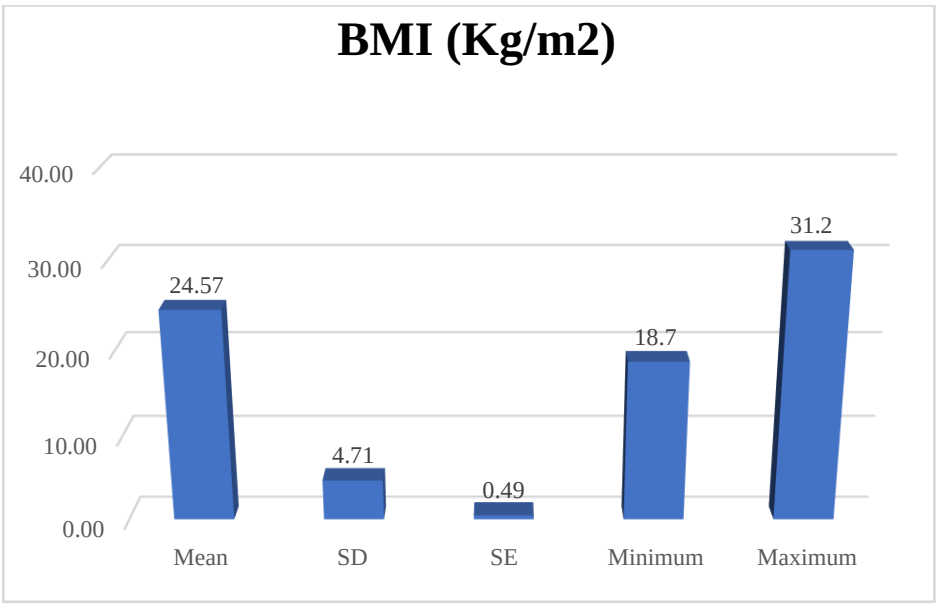
Table 5: Height, weight, BMI, Q-angle and VAS score among study participants:

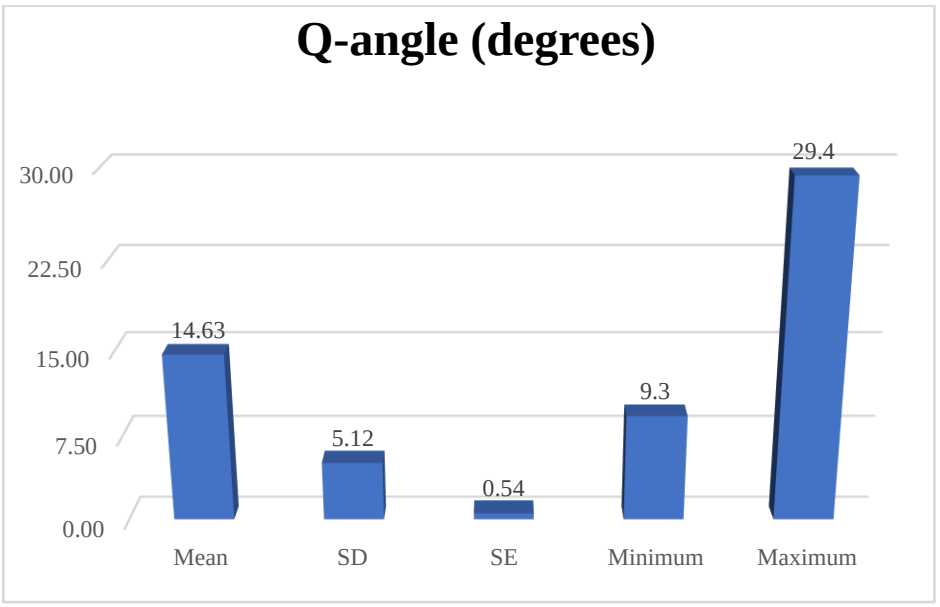
	N	Mean	SD	SE	Minimum	Maximum
Height (cms)	92	158.50	7.52	0.78	131	177
Weight (kgs)	92	62.73	9.85	1.07	45	96
BMI (Kg/m^2)	92	24.57	4.71	0.49	18.7	31.2
Q-angle (degrees)	92	14.63	5.12	0.54	9.3	29.4
VAS Score	92	6.39	1.52	0.37	3	9

Table 6 represents the height, weight, BMI, Q-angle and means VAS scores of the study sample. Overall, the mean Q-angle was 14.63±5.12 (9.3-29.4).




Weight (kgs)
100.00
75.00
50.00
25.00
0.00
62.73
9.85
1.07
45.
96.
Mean
SD
SE
Minimum
Maximum


BMI (Kg/m2)
40.00
30.00
20.00
10.00
0.00
24.57
4.71
0.49
18.7
31.2
Mean
SD
SE
Minimum
Maximum


Q-angle (degrees)
30.00
22.50
15.00
7.50
0.00
14.63
5.12
0.54
9.3
29.4
Mean
SD
SE
Minimum
Maximum

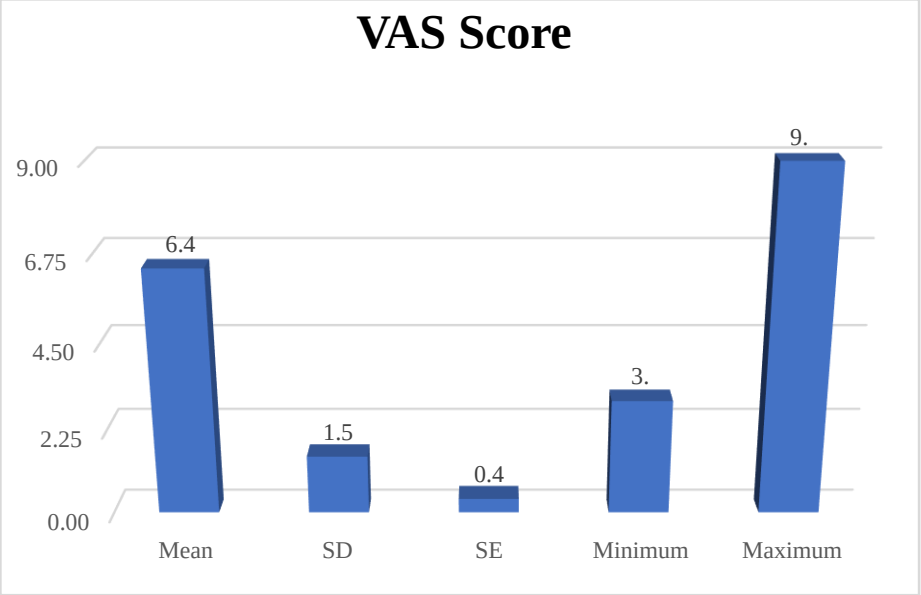


Table 7: Mean clinical Scores compared by gender:

	Male		**Female**		
	Mean	Std. Deviation	Mean	Std. Deviation	p-value
Rt Q-angle	12.54	5.34	12.28	4.65	0.756
Lt Q-angle	13.20	7.35	12.49	4.85	0.446
Avg Q-angle	12.87	6.10	12.39	4.34	0.552

Table 7 presents the mean Q-angle of the study sample compared by gender (unpaired t-test). The difference in right, left and average Q-angle between both male and females were statistically not significant ($p > 0.05$).

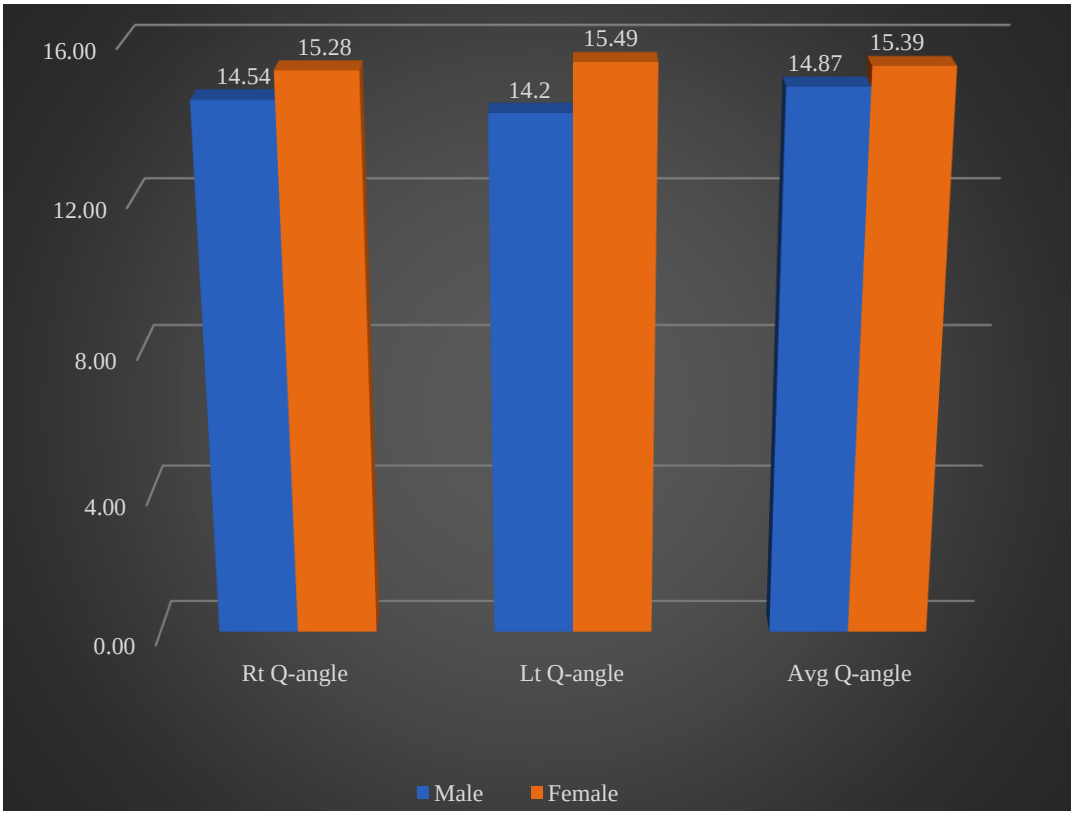


Table 8: Mean clinical Scores compared by age group:

Mean clinical score	19-21 year		22-25 year		26-28 year		p-value
	Mean	SD	Mean	SD	Mean	SD	
Q-angle	17.15	6.17	13.12	3.18	15.10	5.73	0.117
VAS score	4.83	1.72	5.04	1.29	5.62	1.58	0.163

Table 8 presents the mean clinical scores of the study sample compared by age groups (one way ANOVA).

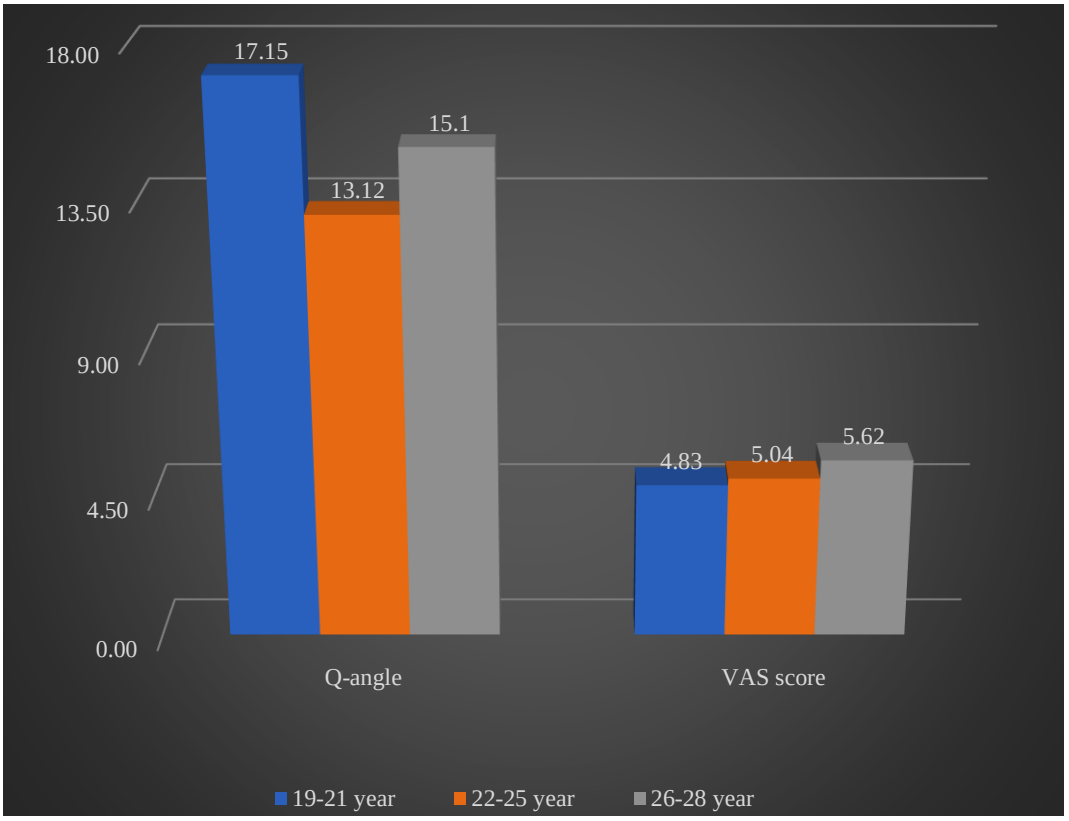


Table 9: Mean clinical Scores compared by socio-economic status:

	Mean	Std. Deviation	p-value
Rt Q-angle	15.34	4.80	0.263
Lt Q-angle	15.65	5.51	

Table 9 presents the mean clinical scores of the study sample compared by side (paired t-test).

The difference in Q-angle between right and left side not significant ($p > 0.05$).

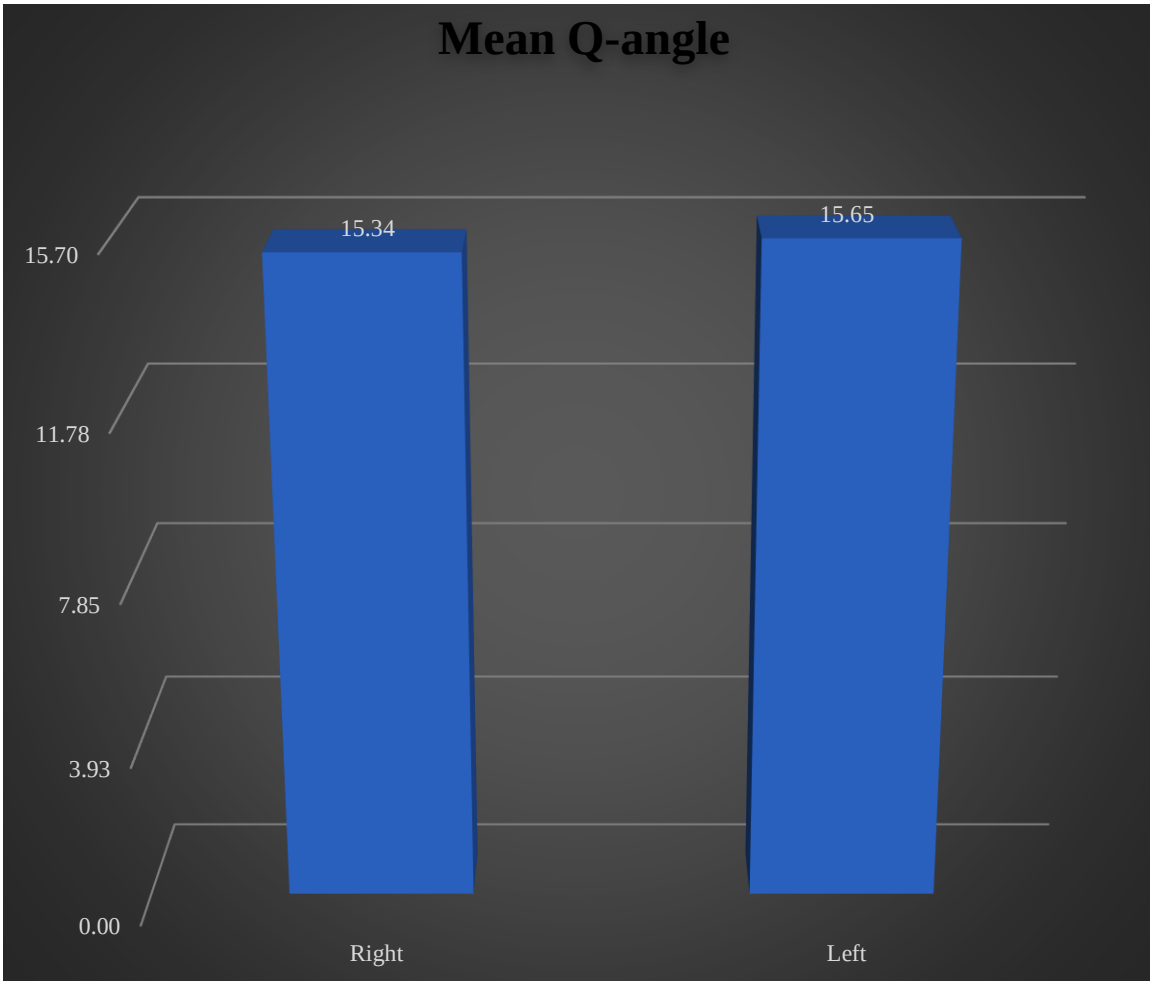


Table 10: Correlation between Q-angle and BMI of study participants (Pearson correlation)

		Q-angle
VAS	Pearson Correlation	0.766
	p-value	0.004*

Table 10 shows there was a significant positive correlation between Q-angle and VAS score.

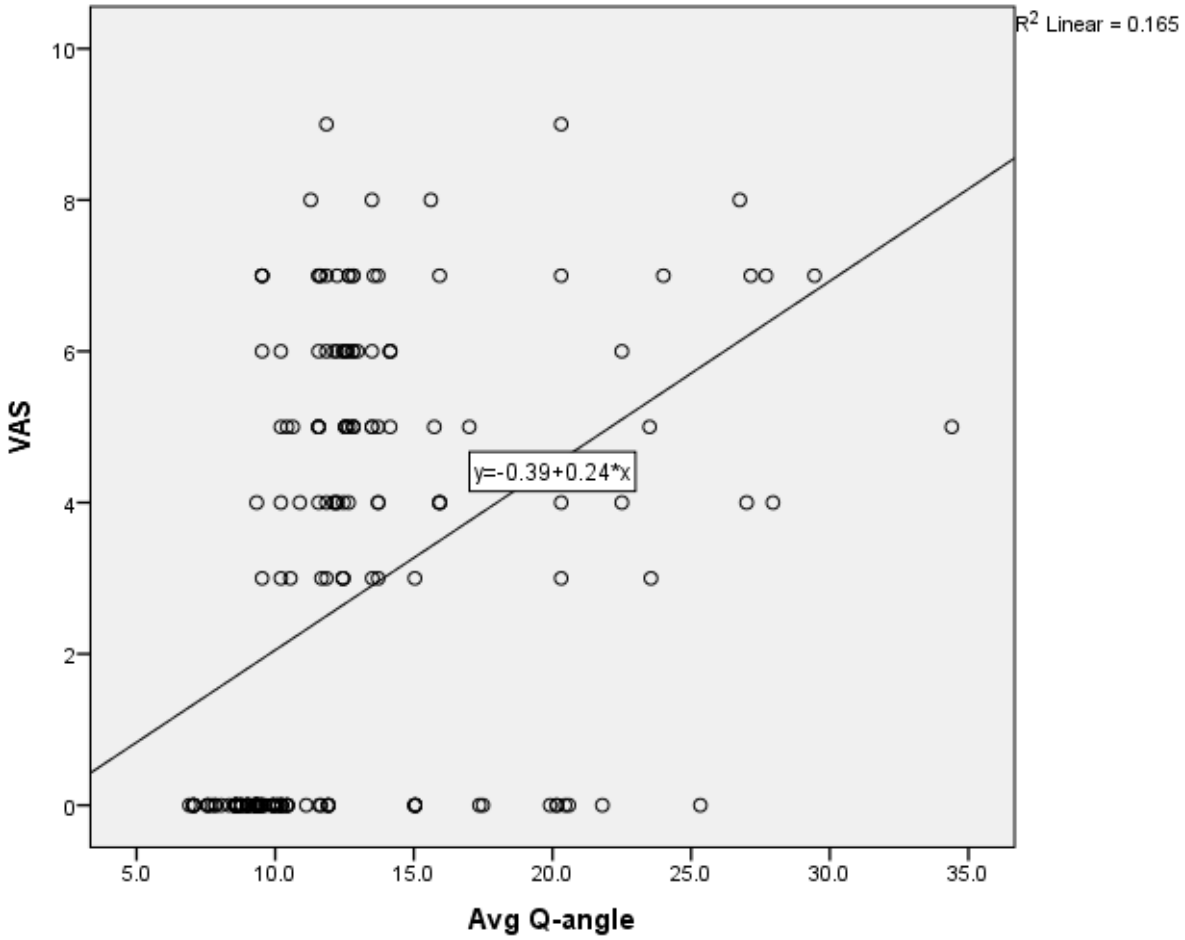
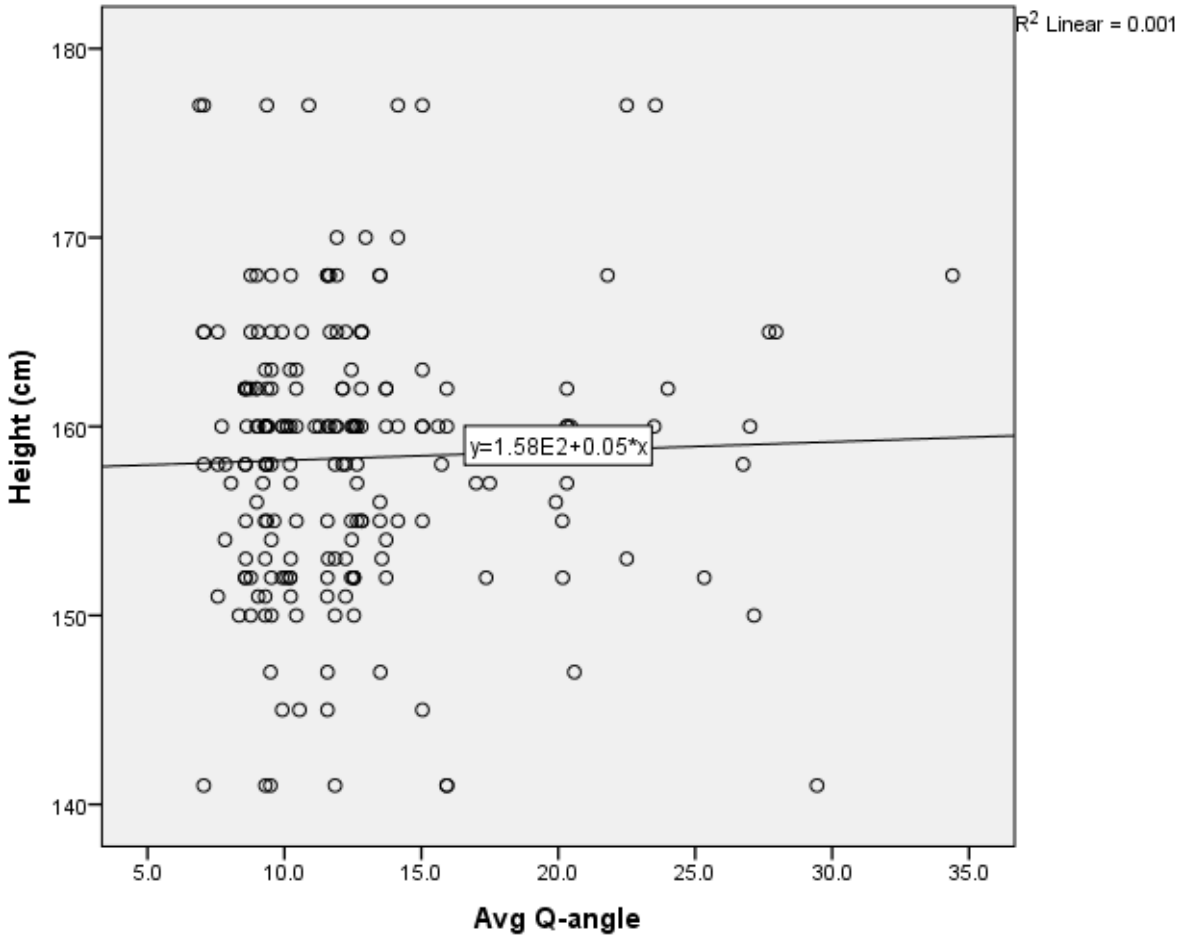
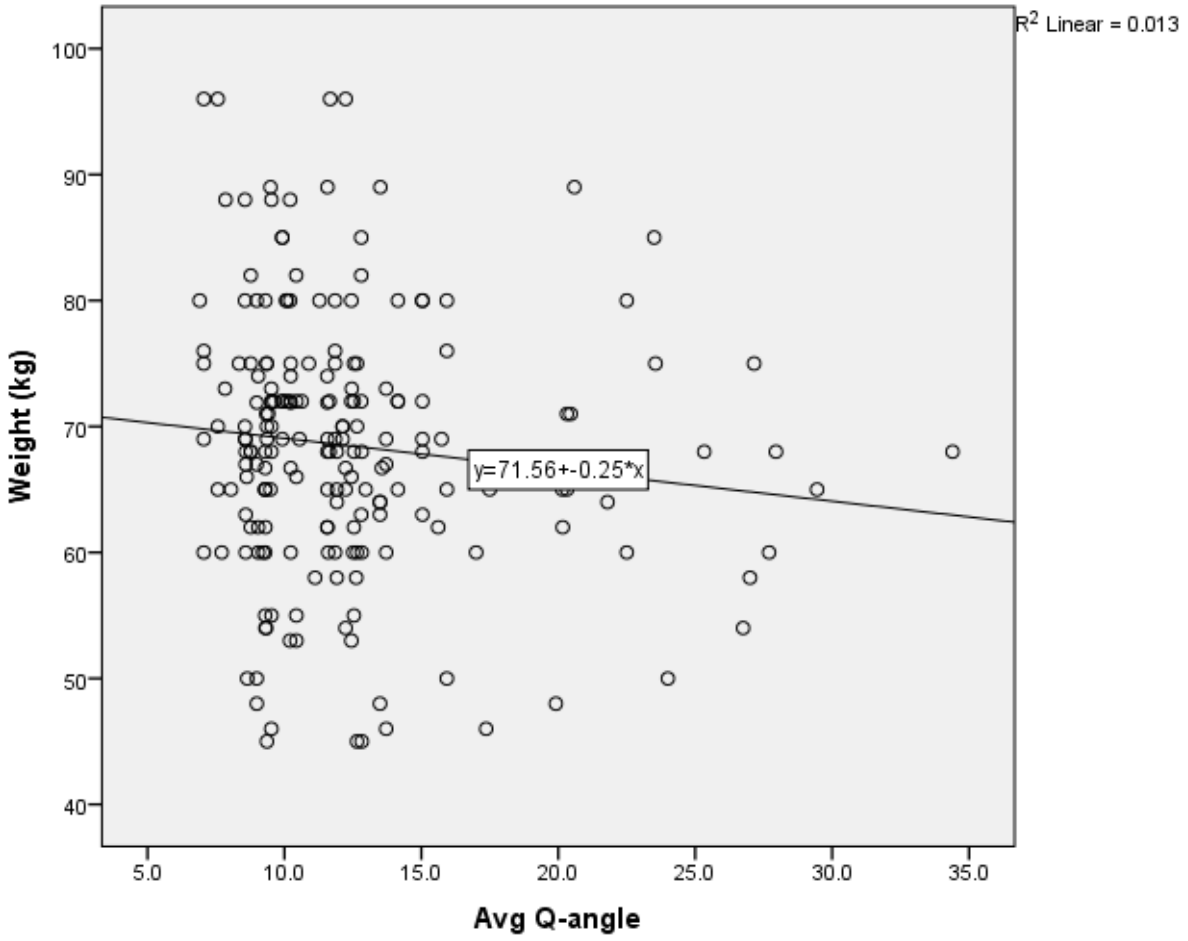


Table 11: Correlation of Q-angle with Height (cm), Weight (kg) and BMI

		Avg Q-angle
Height (cm)	Pearson Correlation	0.032
	p-value	0.656
Weight (kg)	Pearson Correlation	-0.115
	p-value	0.104
BMI	Pearson Correlation	-0.109
	p-value	0.124

There was no significant correlation of Height (cm), Weight (kg) and BMI with Avg Q-angle.


R2 Linear = 0.001
y=1.58E2+0.05*x
Height (cm)
Avg Q-angle
180
170
160
150
140
5.0
10.0
15.0
20.0
25.0
30.0
35.0


R2 Linear = 0.013
y=71.56+-0.25*x
Weight (kg)
Avg Q-angle
100
90
80
70
60
50
40
5.0
10.0
15.0
20.0
25.0
30.0
35.0

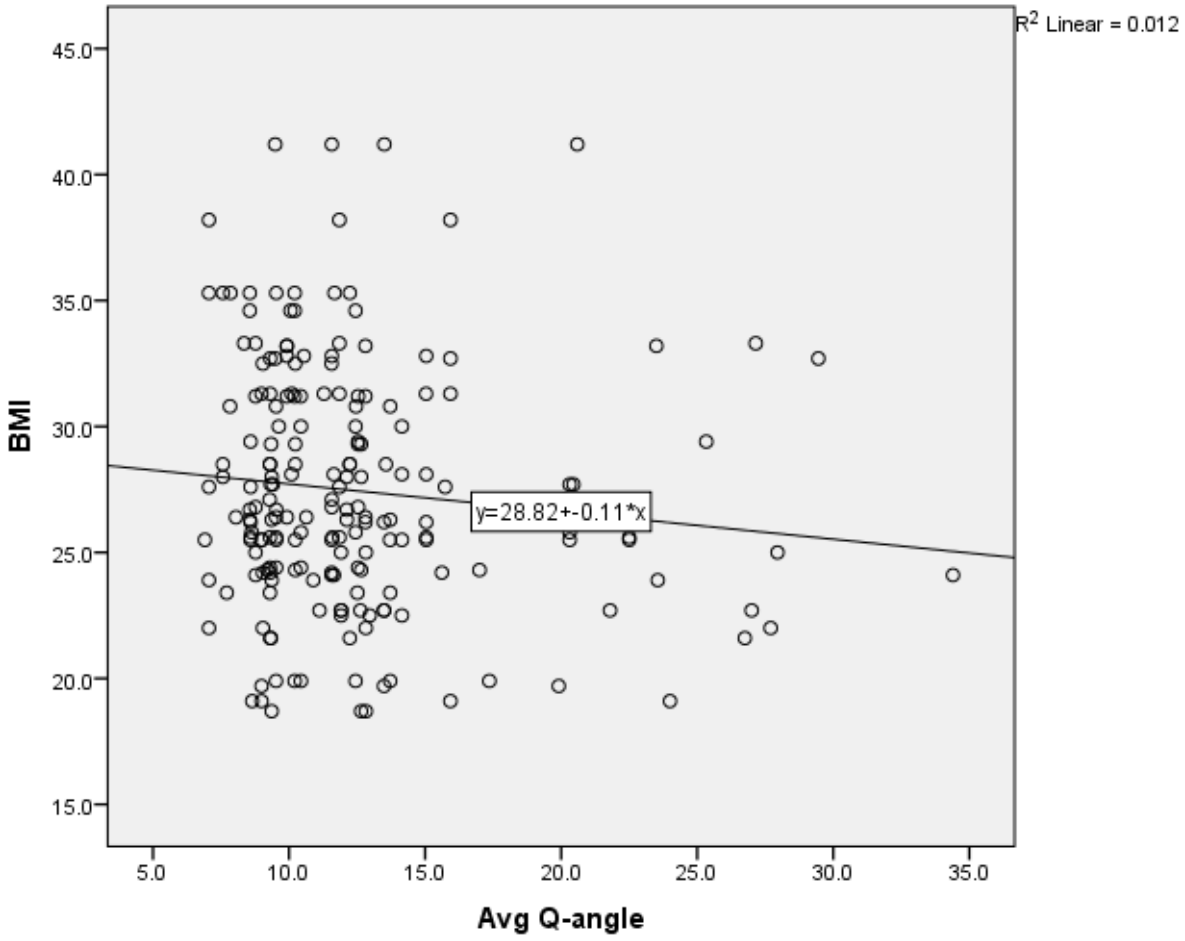

R2 Linear = 0.012
45.0
40.0
35.0
30.0
25.0
20.0
15.0
BMI
y=28.82+-0.11*x
5.0
10.0
15.0
20.0
25.0
30.0
35.0
Avg Q-angle

Table 12: Correlation of VAS score with Height (cm), Weight (kg) and BMI

		VAS
Height (cm)	Pearson Correlation	-0.013
	p-value	0.854
Weight (kg)	Pearson Correlation	0.002
	p-value	0.980
BMI	Pearson Correlation	0.012
	p-value	0.870

There was no significant correlation of Height (cm), Weight (kg) and BMI with VAS score.

DISCUSSION

The terms patellofemoral pain syndrome (PFPS) and anterior knee pain syndrome (AKP) are often interchanged when talking about knee discomfort.[86] The underlying pathology of "runner's knee" is not accurately reflected by any of the common names for the condition, including chondromalacia patella, AKP, and patellofemoral syndrome.[87] Patients who need visits to the orthopaedic sports clinic often encounter AKP.

One of the causes of this discomfort is the abnormal patellar alignment. The Q-angle is a frequently used technique[40] to evaluate such patellar malalignment. The quadriceps femoris muscle and patellar tendon pull together to generate the Q-angle, which is defined as the acute angle formed by this vector.[20] It is a sharp angle between the Anterior Superior Iliac Spine (ASIS) and the midpoint of the patella, which represents the line of pull of the combined quadriceps femoris muscles, and the line connecting the tibial tubercle with the same reference point on the patella, which represents the line of pull of the patellar tendon.[40]

The measurement of that angle can be done in a variety of ways, including having the patient lie on their back with their knee fully extended and their quadriceps relaxed, or contracted, with their knee in a 30° flexion and their quadriceps relaxed, sitting with their knee in a 90° flexion, and standing.[88] Men's and women's average Q angles in a typical topic are 14° and 17°, respectively.[89]

In our study , the age wise distribution of study patients showed that the mean age of the study group was 25.73$\pm$2.35 years (mean$\pm$SD). The maximum number of patients were seen in the 26-28 year age group, having 63% subjects, followed by 22-25 years age group, having 30% subjects, and lastly the 19-21 years age group, having 7% subjects. *Kumar et al*.[76] reported that a mean age of 25.5 years in case and 25.4 years in control group. *Dhakal and Sharma*.[73] found that the patient's age ranged from 16 to 30 years, with an average age of 23.2 years. Most of the patients were between the ages of 21-25 years.

Similar findings were observed by *Samuel RW et al*.[90] in their research with a mean age of 25.1±3.4 years among symptomatic subjects. Similar findings were observed by *Shultz SJ et al*.[91] in their research, which included asymptomatic subjects with a mean age of 25.6±3.2 years. In their research, *Caylor D et al*.[40] revealed mean ages of 24.5 years in the control group and 23 years in the case group. This age group may have a higher prevalence of AKP because they are the most active and participate in more outdoor professional and leisure activities, which increases their susceptibility to stress, strains, and small repeated trauma.[12,39]

In our study, the gender wise distribution in study patients showed that majority of were females (64%) and 36% were males. *Kumar et al*.[76] reported that there were (52 Females and 48 Males. *Dhakal and Sharma*.[73] found that there were 55 males and 45 females. The incidence of AKP is somewhat more common in females in the ratio of 1.4:1 to 2.2:1 in the literature.[92-94] Increased pelvic breadth that causes excessive lateral pressure on the patella, postural issues, and social variables like sitting with the legs adducted may all contribute to the greater occurrence of knee discomfort in women.[43,95]

In our research, a majority of the study sample (40%) had both knees involved in AKP, followed by 33% who had only the right knee involved and 26% who had only the left knee involved. *Kumar et al*.[76] reported that right knees was affected in 38 cases and both knees in 22 cases. Similar findings were observed by *Samuel RW et al*.[90] in their research with a mean age of 25.1±3.4 years among symptomatic subjects. *Dhakal and Sharma*.[73] found that Rights knees were involved in 38 patients; left knees were involved in 38 patients and both knees in 24.

Similar findings were observed by *Shultz SJ et al*.[91] in their research, which included asymptomatic subjects with a mean age of 25.6±3.2 years. In their research, *Caylor D et al*.[40] revealed mean ages of 24.5 years in the control group and 23 years in the case group.

This age group may have a higher prevalence of AKP because they are the most active and participate in more outdoor professional and leisure activities, which increases their susceptibility to stress, strains, and small repeated trauma.[12,39]

In our study, the mean Q-angle was 14.63±5.12 (range = 9.3-29.4). A high Q-angle indicates an abnormally high valgus angle, which influences the biomechanics of the patellofemoral articulation by exerting a laterally directed force, which in turn leads to mal-tracking and excessive pressure on the patellofemoral articulation, which ultimately results in anterior knee pain (AKP).[43] High Q-angle causes a dynamic component of lateral maltracking of the patella, which can be treated by stretching tight lateral structures (vastuslateralis, iliotibial band), strengthening medial structures (Vastus Medialis Obliquus (VMO)), using knee orthoses for patellar stabilization, and using foot orthoses to correct excessive subtalar pronation.[96]

Hahn and Foldspang.[] were two of the pioneers in the field who were among the first to explore bilateral variations in the Q angle. Other workers subsequently reported bilateral changes as a result of this. According to the findings of several of these investigations, the mean Q angle on the right side was higher than that on the left. Although other reports indicated that the mean Q angle was larger on the left side in comparison to the right. These changes were only considered statistically significant in two of the investigations.[40,97]

However, in the eyes of Livingston and Spaulding.,[19] the cause for this disparity is obscure, and the authors make no attempt to provide an explanation for the phenomenon. For Livingston and Mandingo, the difference in values between both sides can be explained by the higher tropism and muscle tone in the dominant limb. This would cause a force on the patella, displacing it and causing the value of the angle to decrease. Additionally, because the dominant limb has a higher tropism, the dominant limb also has a higher muscle tone.[25] According to Raveendranath and colleagues.,[99] the difference in values between the lower

limbs can be attributed to a change in the relative position of the tuberosity of the tibia regarding the centre of the patella. This conclusion was reached after the researchers examined the relationship between the tuberosity of the tibia and the patella.

The difference in Q-angle and VAS Scores among both male and females were statistically not significant. *Chaudhary et al*.[84] found that Females exhibited a greater Q angle value than men. This finding was in line with an earlier research by *Phatama et al*.[85] that looked at 800 knees and found that men's mean Q-angles varied from 12.81 to 1.81 on the right leg to 13.06 to 1.78 on the left leg. Women's average Q-angles on the right and left legs, respectively, were 14.95° and 1.28°. Women who have a bigger Q-angle are more likely to develop AKP.

In the research by Kumar et al.,[76] which found a significant difference in the Q-angle value between the anterior knee pain sample (17.9±4.2) and the normal sample (14.3±3.6), a similar result was attained. Additionally, Caylor et al investigation confirmed these findings. The normal population's Q-angle was 11.1±5.5, with a 1.3 Q-angle difference, whereas the AKP sample's was 12.4±5.1.[40] Finally, a different investigation started by Moss et al. revealed that the AKP population's Q-angle value was greater (17.1°) than that of the general population (15.2°).[100] *Dhakal and Sharma*.[73] found that the mean Q-angle for women was 17.71 degrees, whereas it was 13.81 degrees for men. Q angle and sex had a statistically significant connection.

In our study, there was a significant positive correlation between Q-angle and VAS score. *Phatama KY et al*.[85] observed that higher the Q-angle, the greater the risk of AKP.

There was no significant correlation of Height (cm), Weight (kg) and BMI with Avg Q-angle and VAS score. *Phatama KY et al*.[85] also observed that there was no significant relationship between anthropometric measures (body weight, height, and BMI) and AKP.

In contrast to numerous other research, on some studies discovered a substantial inverse relationship between height and Q-angle,[78,101-103] and that taller people had lower Q-angle values. However, findings of these observation are comparable to those of studies by Choudhary et al and Khasawneh et al, which reported no significant link between Q-angle and body weight,[78,103]

Choudhary et al.[78] observed that age and weight did not exhibit statistical significance with Q angle values. In female students, there was a bilateral negative connection between height and Q angles in both the standing and supine positions. With Q-angle values, weight did not demonstrate statistical significance. Only in supine position on both sides did weight exhibit a statistically significant negative connection with the Q angle.

These results were in line with the findings of a research by Kumar et al., who discovered no connection between Q-angle and BMI. The Q-angle and BMI did, however, show a significant association in a different research by *Prakash et al*.[75] This outcome could be as a consequence of the study's huge number of obese sample populations. With a mean BMI of 22.09±3.25 for the population with AKP and a mean BMI of 21.63±3.285 for the population without AKP, respectively. A comprehensive study by Hart et al. revealed a similar conclusion, concluding that a higher BMI increases the likelihood of developing AKP. Weight and height did not significantly affect AKP,[104] in contrast to BMI. BMI is a risk factor for AKP,[105] which was also agreed upon by Arrebola et al.

SUMMARY AND

CONCLUSION

The study findings can be summarized as follows:

- The mean age of the study group was 25.73±2.35 years with majority in the 26-28 year age group (63%) followed by 22-25 years age group, having 30% subjects, and lastly the 19-21 years age group, having 7% subjects
- There were 64% females and 36% were males
- A majority of the study sample (40%) had unilateral involved in AKP, followed by 33% who had only the right knee involved and 26% who had only the left knee involved
- There was a significant correlation between Q-angle and VAS score for AKP (higher Q angle was associated with higher VAS score).

CONCLUSION

The Q-angle is a straightforward and reliable clinical measurement that may be used to evaluate anterior knee discomfort. The Q-angle is considerably increased in those with symptomatic anterior knee discomfort. There is a statistically significant correlation between Q-angle and knees that suffered from discomfort in the front of the knee.

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INFORMED CONSENT

Name of the patient: Age:

Address: Phone Number:

S.NO: Date:

I have been explained the details of the study entitled **"ASSESSMENT OF Q ANGLE AND IT'S CO- RELATION TO ANTERIOR KNEE PAIN IN YOUNG ACTIVE POPULATION BETWEEN AGE GROUP 19 TO 28 YEARS_**"and my questions regarding the study have been answered to my satisfaction in a language understood by me.

I understand that I have the right to withdraw from the study at any time and to decline to answer any particular question.

I understand that my participation in this study is confidential and that no material that could identify me will be used in the analysis and in any reports based on this study.

I hereby provide my consent in the study entitled **"ASSESSMENT OF Q ANGLE AND IT'S CO- RELATION TO ANTERIOR KNEE PAIN IN YOUNG ACTIVE POPULATION BETWEEN AGE GROUP 19 TO 28 YEARS"**

Signature/ thumb impression of the patient

Signature/ thumb impression of witness

सूचित सहमति

रोगी का नाम: आयु:

पता: फोन नंबर:

क्र.सं.: दिनांक:

मुझे हकदार अध्ययन का विवरण समझाया गया है ""ASSESSMENT OF Q ANGLE AND IT'S CO-RELATION TO ANTERIOR KNEE PAIN IN YOUNG ACTIVE POPULATION BETWEEN AGE GROUP 19 TO 28 YEARS". अध्ययन के संबंध में मेरे प्रश्नों का उत्तर मेरी समझ में आने वाली भाषा में मेरी संतुष्टि के अनुसार दिया गया है।

मैं समझता हूं कि मुझे किसी भी समय अध्ययन से हटने और किसी विशेष प्रश्न का उत्तर देने से इनकार करने का अधिकार है।
मैं समझता हूं कि इस अध्ययन में मेरी भागीदारी गोपनीय है और कोई भी जानकारी जो मुझे पहचान सकती है, विश्लेषण में और इस अध्ययन पर आधारित किसी भी रिपोर्ट में उपयोग नहीं की जाएगी।

मैं इसके द्वारा हकदार अध्ययन में अपनी सहमति प्रदान करता हूं "ASSESSMENT OF Q ANGLE AND IT'S CO- RELATION TO ANTERIOR KNEE PAIN IN YOUNG ACTIVE POPULATION BETWEEN AGE GROUP 19 TO 28 YEARS"

रोगी के हस्ताक्षर/अंगूठे का निशान

साक्षी के हस्ताक्षर/अंगूठे का निशान

Case History Performa

Date:

Name: Age:

Weight: Height: BMI:

OPD Reg No: Occupation:

Address:

Socio-economic status:

Chief Complaint:

H/o Present Illness:

Medical History:

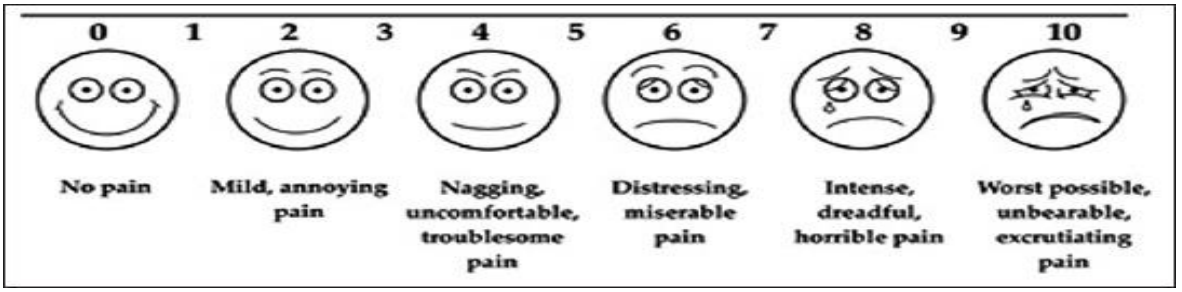
Treatment/Drug history:

Q-Angle (in standing position):

Position of measuring Q-Angle:

Final Diagnosis:

Visual Analog Score:



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